

Appl. No. 10/707,390
Docket No. PES-D-02-038/PES-0183

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims:

1. (currently amended) A gas regulation system, comprising:
a manifold;
a plurality of control modules in fluid communication with the manifold, wherein each control module comprises an actuatable valve in fluid communication with an associated gas storage device; and
a power source in electrical communication with each of the actuatable valves, wherein the power source has sufficient power output to actuate only one of the actuatable valves at a time to an actuated state and insufficient power output to simultaneously actuate more than one of the actuatable valves to ~~is configured to prevent more than one of the actuatable valves from simultaneously having an actuated state, and~~
~~each one of the control modules further comprising a housing, gas connectors, electrical connectors, and a gas storage device connector.~~
2. (original) The gas regulation system of Claim 1, further comprising a directional pressure-reducing device disposed between the manifold and the control modules.
3. (original) The gas regulation system of Claim 1, further comprising a directional pressure-reducing device disposed between each control module and its associated gas storage device.

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4. (original) The gas regulation system of Claim 1, further comprising an impedance safety monitor device in electrical communication with the power source.

5. (original) The gas regulation system of Claim 4, further comprising a shutoff disposed between the power source and the impedance safety monitor device, wherein the shutoff is responsive to interrupt a power signal from the power source.

6. (original) The gas regulation system of Claim 1, wherein each one of the control modules further comprises a local control-processing unit in electrical communication with a manifold controller.

7. (previously presented) A gas regulation system, comprising:
a manifold;

a plurality of control modules in fluid communication with the manifold, wherein each of the control modules comprises an actuatable valve in fluid communication with an associated gas storage device, each of the actuatable valves having a known resistance in an actuated state, and a local control-processing unit in electrical communication with a manifold controller;

a resistance-based interlock defined by an electrical series of resistances of each of the actuatable valves, the interlock being active in response to one of the actuatable valves being in an actuated state, thereby defining a threshold resistance comprising the known resistance;

a power source in electrical communication with each of the actuatable valves, the power source having a power output insufficient to overcome the threshold resistance, thereby preventing more than one of the actuatable valves from simultaneously having an actuated state; and

each gas storage device comprising a unique identifier readable by the manifold controller.

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8. (canceled)

9. (original) The gas regulation system of Claim 1, wherein the actuatable valve comprises a solenoid actuated valve.

10. (original) The gas regulation system of Claim 1, wherein each of the actuatable valves comprises a circuit comprising a switch in electrical communication with the actuatable valve and the power source, wherein each of the circuits are in series.

11. (previously presented) The gas regulation system of Claim 6, further comprising a test module in electrical communication with the manifold controller.

12. (original) The gas regulation system of Claim 2, wherein the pressure reducing valve comprises a check valve adapted to provide a substantially unimpeded flow of a gas from the manifold to the control modules and to reduce a pressure of the gas flowing from the control modules to the manifold.

13. (original) The gas regulation system of Claim 1, further comprising an electrochemical cell system in fluid communication with the manifold, wherein the electrochemical cell system comprises a fuel cell, an electrolyzer, or both a fuel cell and an electrolyzer.

14. (original) The gas regulation system of Claim 10, wherein the power source is in electrical communication with a manifold controller adapted to provide operational logic to each of the circuits of the actuatable valves.

15. (original) The gas regulation system of Claim 1, wherein the gas is a hydrogen gas.

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16. (previously presented) A process for operating a gas regulation system, wherein the gas regulation system comprises a manifold, a plurality of control modules in fluid communication with the manifold, a resistance-based interlock, and a power source in electrical communication with the plurality of control modules, wherein each of the control modules comprises an actuatable valve in fluid communication with an associated gas storage device, the actuatable valve having a known resistance in an actuated state, and a circuit comprising a switch in electrical communication with the actuatable valve and the power source, wherein the resistance-based interlock is defined by an electrical series of resistances of each of the actuatable valves, the interlock being active in response to one of the actuatable valves being in an actuated state, thereby defining a threshold resistance comprising the known resistance, the process comprising:

closing a selected one of the switches; and

energizing the circuit defined by the closed switch to open the associated one of the actuatable valves, wherein energizing the circuit comprises supplying power to the circuit to enable actuation of the associated one of the actuatable valves, wherein the power is insufficient to overcome the threshold resistance and to actuate the associated one of the actuatable valves if more than one of the switches is closed, thereby preventing more than one of the actuatable valves from simultaneously having an actuated state.

17. (original) The process of Claim 16, further comprising:

opening a valve disposed between the manifold and the plurality of the control modules; and

flowing a gas between the control modules and the manifold.

18. (original) The process of Claim 16, further comprising:

initiating a test upon startup of the gas regulation system, wherein the test comprises commanding each one of the switches to close to provide confirmation of a complete connection.

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19. (original) The process of Claim 16, further comprising reducing a gas pressure flowing from the plurality of control modules to the manifold.

20. (original) The process of Claim 16, further comprising reducing a gas pressure flowing from the gas storage device to the control module.

21. (original) The process of Claim 16, further comprising monitoring the power from a power source to the circuits and interrupting the power in the event of an actionable event.

22. (original) The process of Claim 17, wherein the flowing a gas comprises flowing a gas from the manifold toward the control modules at a pressure of equal to or greater than about 2000 psi.

23. (original) The process of Claim 17, wherein the flowing a gas comprises flowing a gas from the plurality of control modules toward the manifold at a pressure of equal to or less than about 200 psi.

24. (original) The process of Claim 23, wherein the flowing a gas further comprises flowing a gas from one of the plurality of control modules.

25. (previously presented) A gas regulation system, comprising:
a power source;
a manifold;
a plurality of control modules, each of the control modules comprising:
a processing unit responsive to an external control signal; and
an actuatable valve responsive to the processing unit and the power source,
and adapted for fluid communication between a gas storage device and the manifold, the actuatable valve having a known resistance in an actuated state;

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a resistance-based interlock defined by an electrical series of resistances of each of the actuatable valves, the interlock being active in response to one of the actuatable valves being in an actuated state, thereby defining a threshold resistance comprising the known resistance;

wherein the power source has a power output insufficient to overcome the threshold resistance, thereby preventing more than one of the actuatable valves from simultaneously having an actuated state;

wherein only one of the actuatable valves opens to provide fluid communication between the gas storage device and the manifold in response to a signal from the processing unit and in the absence of another of the actuatable valves of a second control module of the plurality of control modules being open.

26. (original) The control module of Claim 25, further comprising:

a switch in signal communication with the processing unit and adapted to receive power from the power source; and

an impedance device disposed between the switch and the actuatable valve;

wherein the actuatable valve is responsive to the impedance device for switching between a closed and an open position;

wherein the power from the power source is sufficient to drive no more than one impedance device to an actuatable state for opening the actuatable valve; and

wherein the actuatable valve opens to provide fluid communication between the gas storage device and the manifold in response to the impedance device being driven to the actuatable state.

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27. (original) The control module of Claim 26, further comprising:

a first gas connector and a second gas connector, each gas connector in fluid communication with the actuatable valve, and each gas connector adapted for fluid communication with an adjacent control module; and

a first electrical connector and a second electrical connector, each electrical connector in signal communication with the processing unit, and each electrical connector adapted for signal communication with the adjacent control module;

wherein a plurality of control modules may be daisy chain connected via the gas connectors and the electrical connectors thereby providing a modular arrangement of control modules.

28-30. (canceled)

31. (previously presented) The gas regulation system of Claim 1, wherein each one of the control modules further comprise one or more of gas connectors and electrical connectors.

32. (previously presented) The process of Claim 16, further comprising:
reading a unique identifier associated with each gas storage device for tracking operational information relating to each gas storage device.

33. (new) The gas regulation system of Claim 1, wherein:
each one of the control modules further comprises a housing, gas connectors, electrical connectors, and a gas storage device connector.